

Project Requirements Document

SmartNet

Team Members

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Introduction

Problem

Wi-Fi signal strength is very fickle and can vary from location to location within a building/residence. This leads to the emergence of dead spots, where the quality of the connection is significantly lower than advertised. ISP technicians need a way to determine where these dead spots are that they can place routers/extenders in optimal positions to minimize the spots' occurrences. There are Wi-Fi strength analyzers currently out there; however there are very few good mobile ones.

Our Solution

SmartNetwork is a mobile Android application that helps ISP technicians and/or residential users strategically setup Wi-Fi routers for maximum coverage. Users can generate a heatmap that displays the signal strength from the router to any points in the building. In addition, there is a Wi-Fi speed analyzer and video stream analyzer which users can use to test the connection from wherever they are.

ISP technicians can also bring up the router's captive GUI portal through the app. This way, they don't have to go to the router's IP address to configure it.

The app also will push the location of the router onto the router itself, as well the heatmap data associated with that router. This will allow ISPs to pull that data from their routers to generate their own heatmaps for neighborhoods and communities.

Background

When installing routers, it is beneficial to see the coverage from one part of a building compared to another. This way, a user can see where the weak and dead spots are and adjust the router accordingly, either by moving the router or installing mesh extenders. It would also be convenient if an individual can walk around the building to test WiFi coverage. SmartNetwork is an app that will allow you to do all these things. With a simple and easy-to-use interface, any technician and/or home user can easily generate Wifi Heatmaps and configure routers all from their Android device.

This app is a continuation of last year's Capstone project. The previous team had already implemented the Wi-Fi Speed Analyzer and a basic heatmap function. We will be building upon their code and adding new features. These include porting in a video stream analyzer, bringing up the router's captive GUI portal in the app, and pushing the router's pin onto the router.

The video stream analyzer is a single C file provided by SmartRG. It will listen in on video streams and output JSON data about the quality of the streams, including metrics such as packet loss and error rate. The app will visualize this data by graphing the relevant metrics that measure network quality, such as the aforementioned metrics.

Assumptions

- Routers are up and running
- Android device is connected to Wi-Fi

Goals and Objectives

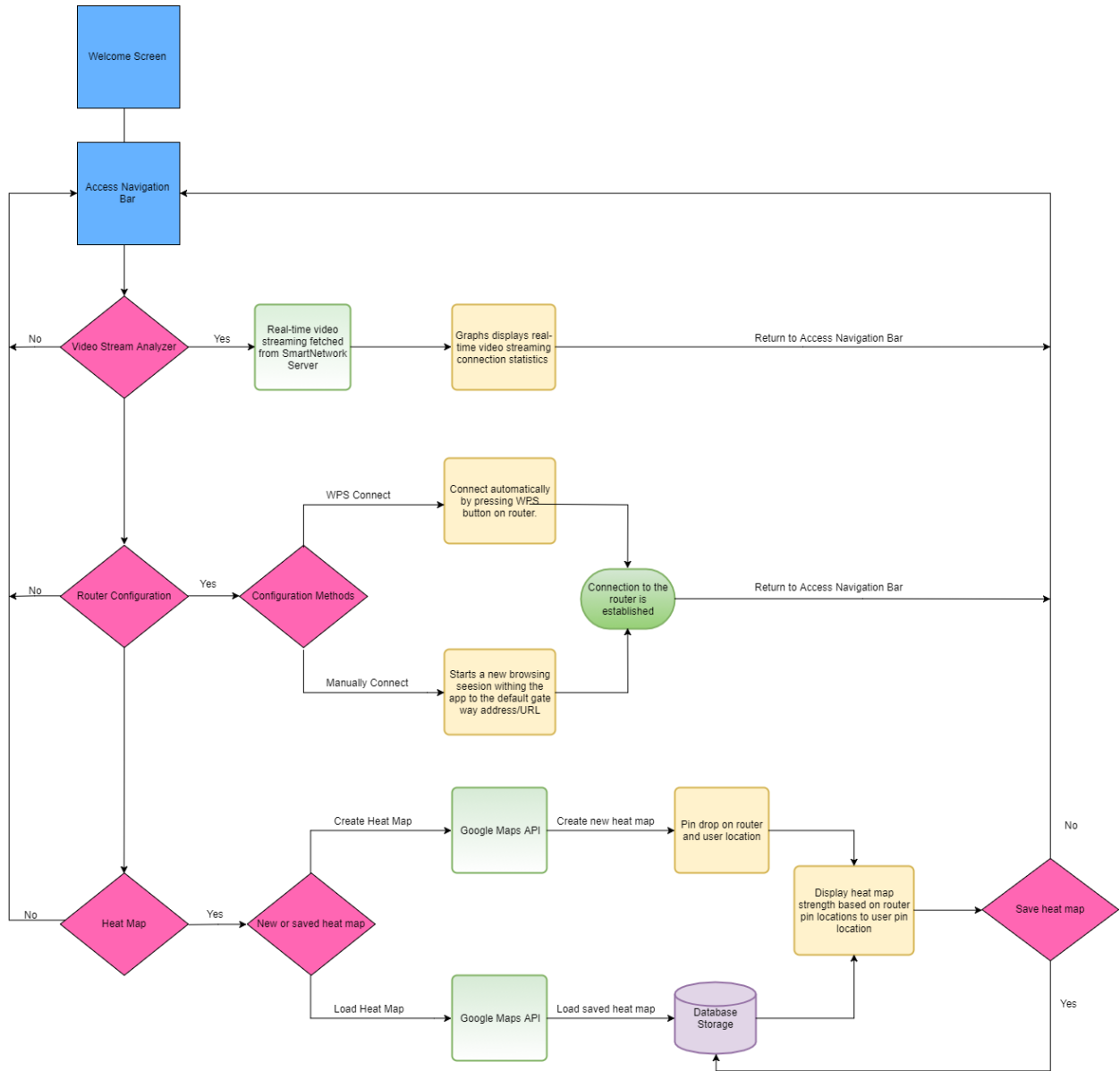
Base Goals

- Port the VSA file onto Android
- Get the data from the VSA and visualize it into a real-time graph
- Get the router's captive GUI page and display it in the app
- Push the location of the router onto the router itself
- Create a training video for the app

Stretch Goals

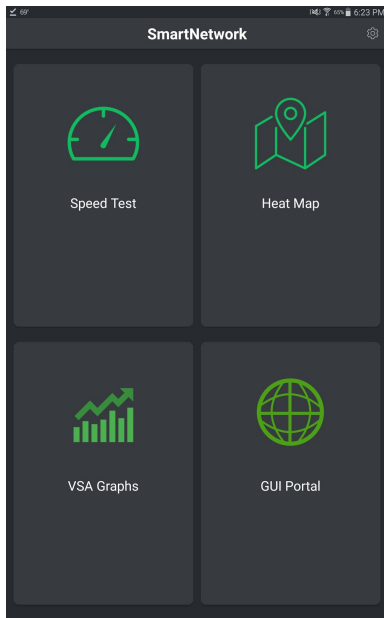
- Improve the heatmap so that whenever two test pins are dropped, the heatmaps will automatically merge together
- Based on heatmap, have the app determine the optimal spots to place mesh extenders

System Architecture Overview

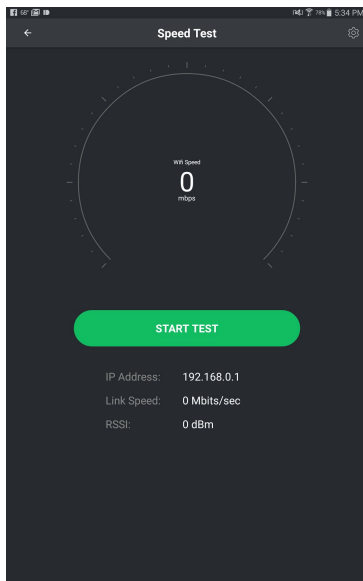


User Interaction and Design

When the App is first launched, the user is brought to the home screen. From here, they can utilize multiple features of our App.

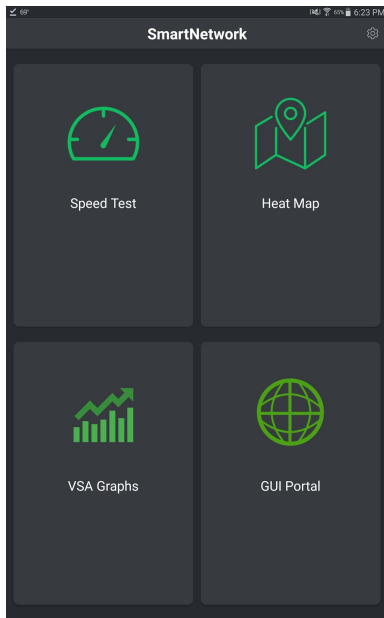


Upon pressing the Speed Test button, the user is brought to a new activity that looks like this:

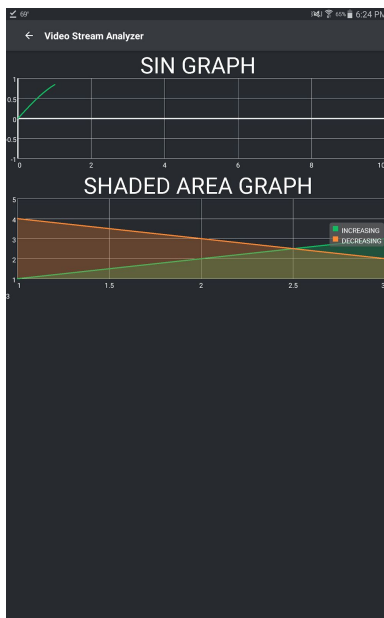


From here, if connected to a SmartRG Router, they can press the speed test button to begin performing a speed test.

After the user is done, then can press the back button, to be taken back to the home page.

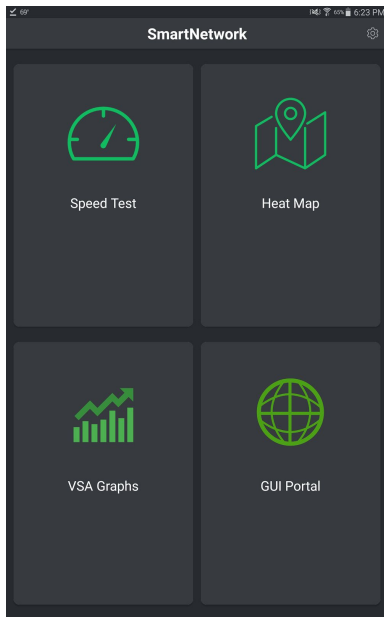


Back at the home screen, the user can press the VSA Graphs button, to be take to a new activity display VSA data in graph format.

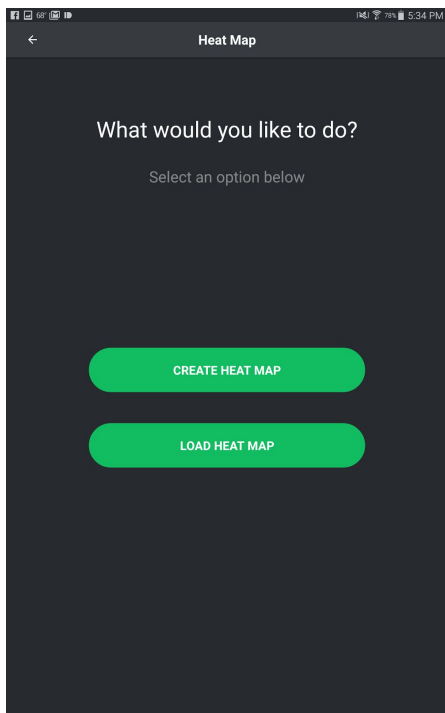


Here, multiple graphs will represent data collected from the Video Stream Analyzer, and the user can scroll through and view all the graphs.

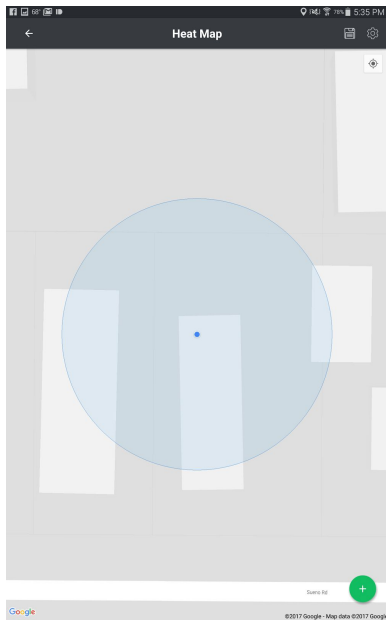
Again, the user can press the back button to be returned back to the home screen.



The user can press the Heat Maps button, to be taken to an intermediary activity where they can decide to either create a new heat map, or load an existing one.



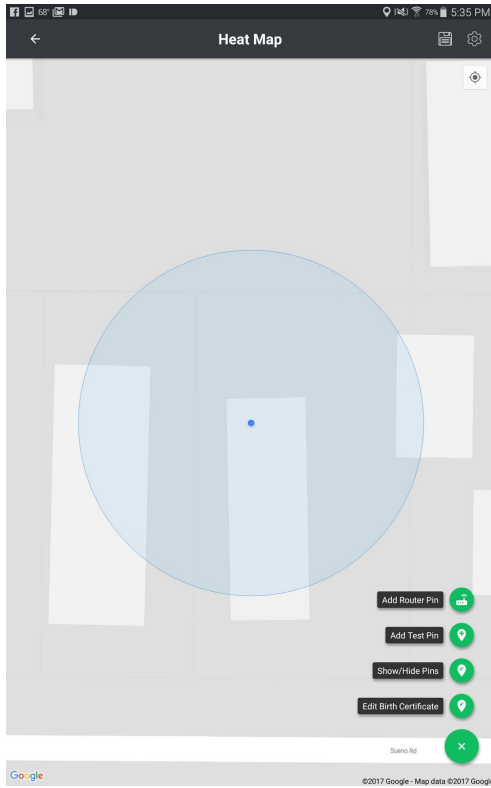
If the user decides to create a new heat map, they will be taken to an activity, with a google maps background at their location.



Before creating a heat map, the user would need to place a router pin, and update its birth certificate if they have not done so already.

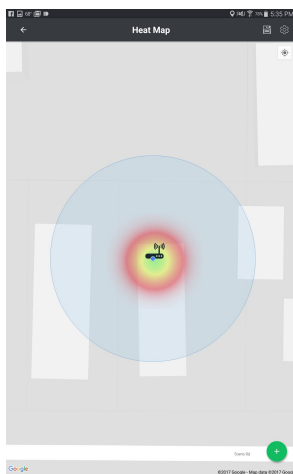
To begin this process. The user would need to click on the green plus button in the bottom right of the screen.

Upon pressing the button, the following options will show up.



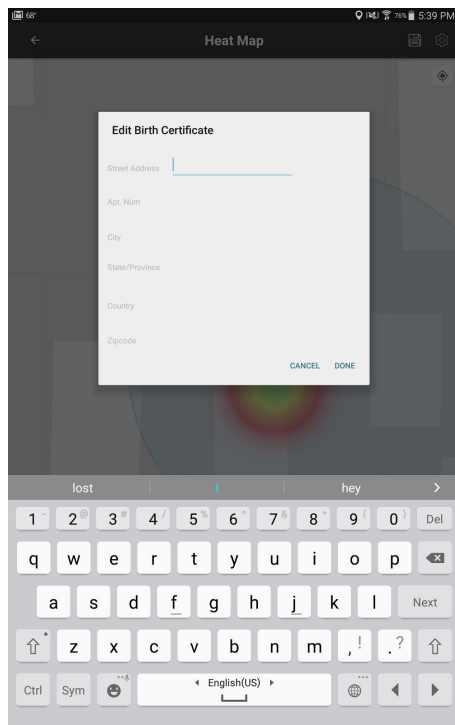
The user should then press the Add Router Pin button, and then click on their location on the map.

After clicking on their location, a router will appear in the location of the click.



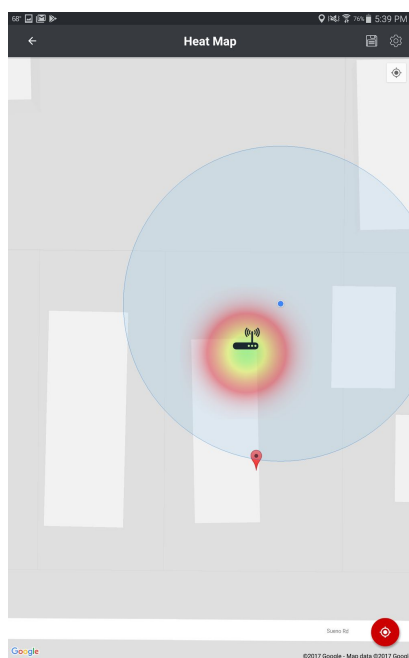
Once the user is satisfied with the location. They should press the green plus button again, and then click Edit Birth Certificate.

This should bring them to the following form, which would need to be filled out.

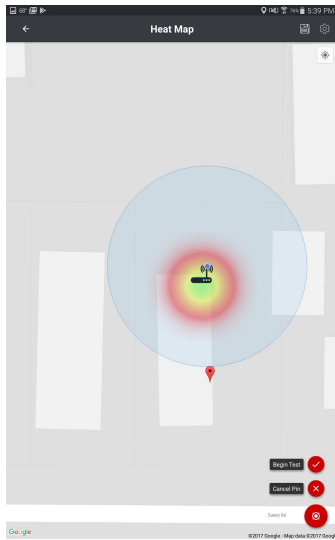


Once done, the user can press the green plus again, and this time add test pin. They should then click on their location (where they wish to run the test).

After clicking on the location, a red pin should pop up on the map, in the location that was clicked.

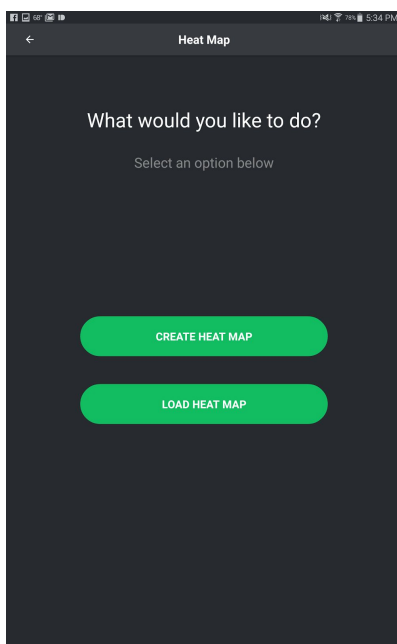


Once satisfied with the location, the user can click the now red plus in the bottom of the screen, and then begin test, to start the test.

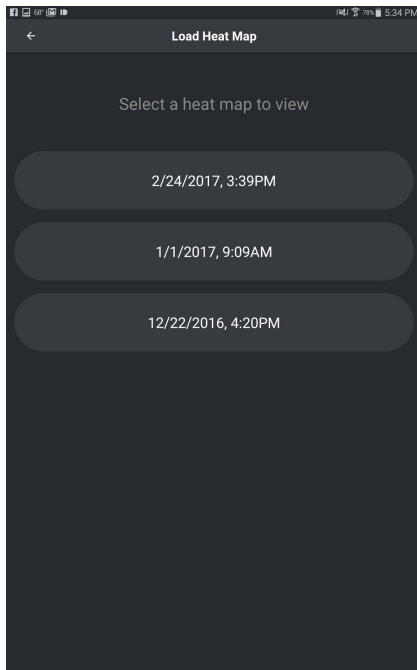


The user can then continue to place pins and run tests, creating a heatmap of the entire area.

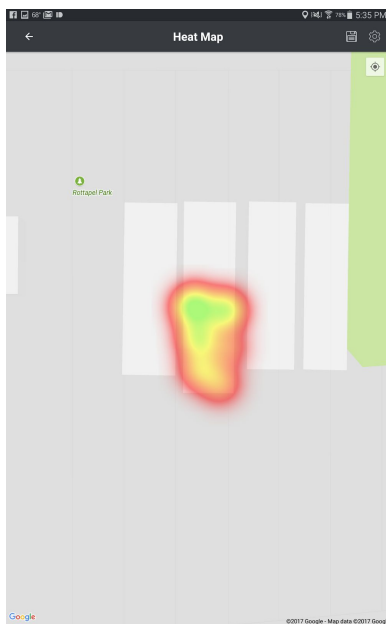
Going back to the previous screen (This can be accomplished by pressing the back button, or going back to the home screen and pressing the Heat Maps button again), the user can load an existing heat map that has been saved.



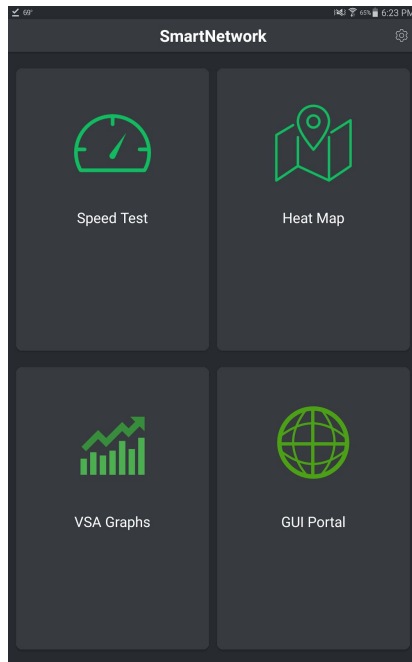
After pressing Load Heat Maps, a list of all available heat maps will become available to the user.



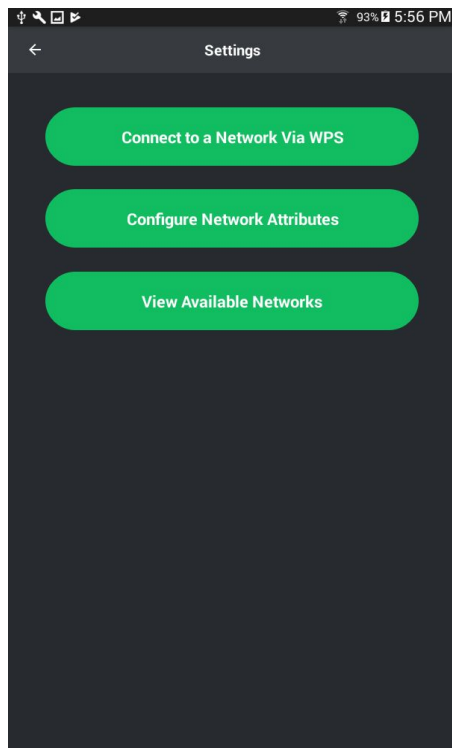
After they click and select the one they wish to load, the saved heatmap will show up on the screen.



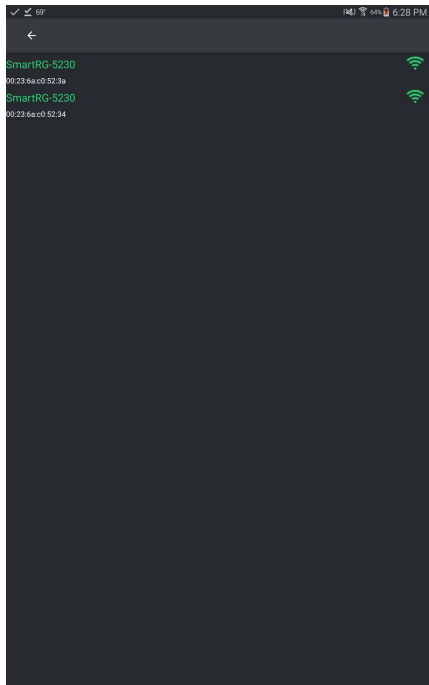
If we go back to the home screen, the user has access to another feature labeled as GUI Portal.



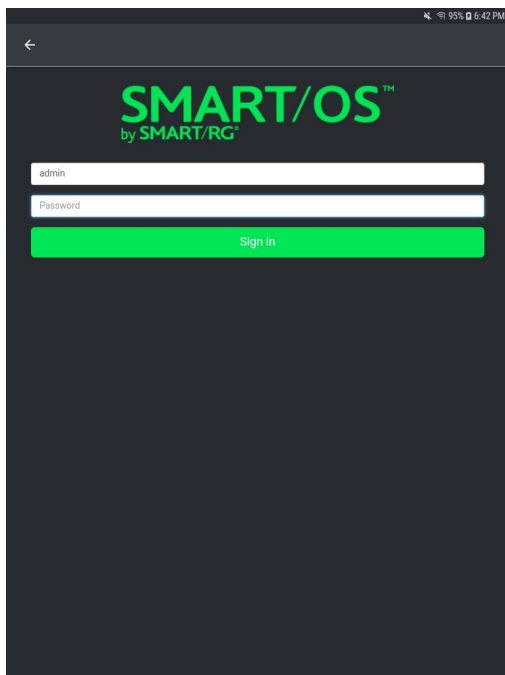
If the user clicks the GUI Portal button, they will be brought to a screen where they can easily connect to SmartRG Routers.



When the user presses the View Available Networks button, they will be shown a list of all SmartRg Routers that are open networks (Have no password).



If we go back and press the Configure Network Attributes button, we get redirected to the default router gateway page, where we can login and access the router settings.



Requirements

Functional

- Allow easy access to ISP GUI portal to configure and connect router.
- Drop pins in locations of your router(s).
- Create a heat map of your wifi signal strength
- Run a Video Stream Analyzer and view the data outputted in an easy to read graph format.
- Perform a speed test directly with the router to determine wifi speeds.

Nonfunctional

- Application should be intuitive and easy to use.
- Graphs should be well formatted and easy to read and analyze.
- Graphs should be updated in real time.
- Process Network data in real time

User Types

- **Router Technician:** A person who is installing, updating, and maintaining routers in a customer's home.
- **Private User:** A person, not a router technician, who would like to personally analyze and maintain their routers.

User Stories / Use Cases

- As a technician, I want to look at the VSA graph that records packets lost during video streaming so that I can determine if our IPS video streaming connection is acceptable to our customers.
 - Acceptance Test: After the test is complete, there should be a graph and analytics page displaying packet information.

- As a technician, I will make use of the Video Stream Analyzer feature to get a better insight of what areas of the house receive poor Wifi reception during video streaming.
 - Acceptance Test: Upon pressing the VSA Graphs button, an activity with different graphs should pop up and display different wifi signal metrics.
- As a technician, the Video Stream Analyzer feature will help me know where repeaters are needed in order to have better Wifi signal throughout the house.
 - Acceptance Test: Upon running the video stream analyzer, I should get a graph with relevant data relating to wifi signal strength at locations.
- As a customer and technician, I will use an already existing web application embedded into the app in order to configure router settings with ease.
 - Acceptance Test: Upon pressing a button designed to take the user to a web page, a web page with the designated IP address should be opened and loaded.
- As a technician, I can navigate to the GUI portal option in order to setup the router along with all of its configurations such as custom password, and SSID.
 - Acceptance Test: Upon opening the GUI portal, navigation throughout the portal should be as if the page is loaded through an internet browser.
- As a user, I can click on the “WPS Router” button and it will take to me to a page that allows me to configure my router’s SSID.
 - Acceptance Test: Upon pressing the button, a web view with the website should open within the app.
- As a user, I can press the back button built in the app and it will allow me to conveniently go back to me previous page activity.
 - Acceptance Test: Upon pressing the back button, the activity should return to the previous activity.
- As a user, I can create a heatmap of the wifi strength of my house, so that I can see how signal strength varies throughout my house.
 - Acceptance Test: After all points have been tested, a fully connected heat map should be displayed over the map.
- As a user, I can drop a location pin on my router, so that I know where it is in the house.
 - Acceptance Test: After a pin drop, router icon should be present in the location the user dropped the pin.

- As a user, I can run a speedtest on my wifi that interacts directly with my router, so that I can get a good idea of the speeds I am getting.
 - Acceptance Test: After a test. The wifi speed should be displayed, similarly to other speed tests, such as [speedtest.net](https://www.speedtest.net)
- As a user, I can open the heatmap feature and a new router pin will be placed based on my current position.
 - If the router's pin position is not accurate, the user will be given the option to remove the pin and manually place the router pin.
- As a technician, I can click the “view available networks” button to view all SmartRG networks near me.
 - Acceptance Test: If there are no SmartRG access points available, I will see a list with all available wifi networks near me.
- As a technician, after I click the SmartRG network I want to set up, the app will redirect me to a browser built in within the app.
 - Acceptance Test: The first time the technician sets up the access point, the app will redirect to the quickstart URL.
- As a technician, after I set up the SmartRG access point and connect to it, the app will redirect me to an URL with the SmartRG IP.
 - Acceptance Test: After the connection to the network is successful, the app will store the IP of the network I am connected to in a string, and I will be able to navigate to that IP since the connection has been successful. Otherwise, an error will be displayed.
- As a technician, when I am in the activity that displays the list of networks available, I can swipe down on the screen to have that list refreshed.
 - Acceptance Test: Upon swiping down, the app will refresh the list of available networks.
- As a technician, when I am in the activity that displays the list of networks available, I can click the button to refresh the list of networks again (Button meant for Android users).
 - Acceptance Test: Upon clicking on the button, the app will refresh the list of available networks.
- As a technician, after I am done connecting to an access point, I can click the back button.
 - Acceptance Test: Upon clicking the back button, the user will be taken to the previous activity they were in (GUI Portal).
- As a user, I can save my work of a heatmap for any home.
 - Acceptance Test: The user will click on the save icon and the app will prompt the user with what is know as a “Birth Certificate”.

- As a user, I can save time by not having to input residence information to the Birth Certificate.
 - Acceptance Test: The app will auto fill all user input based on longitude and latitude. The user may need to manually enter unit number if residence is at an apartment complex.
- As a technician, I can go to a residence and pull up previously saved birth certificated and edit them accordingly
 - A technician will be allowed to load saved heatmaps and edit the attributes of the birth certificate such as customer's name, unit number, etc.
- As a user, after I place a router pin, the area covered by the WiFi signals will be colored in green, orange and red.
 - Upon zooming in or out of the map, the areas covered by the wifi radius will remain to scale.

Prototyping Code/Tests

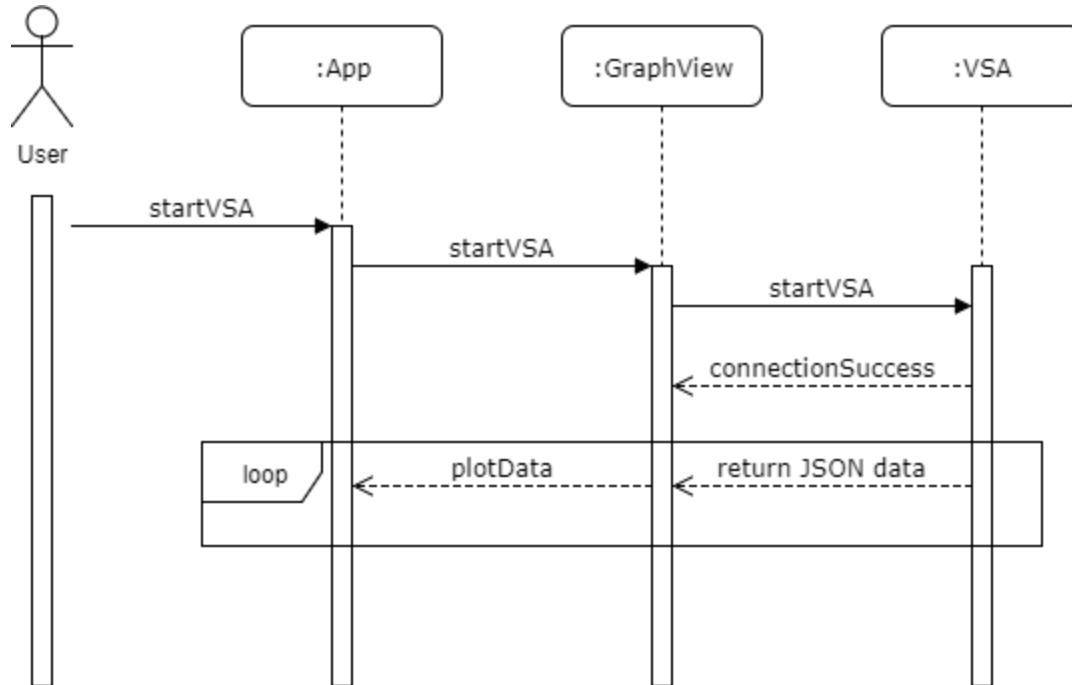
- [Android App](#) Private Repo, Active Development.
- [Android App](#) Public Repo, may be out of date, and missing more sensitive code.
- [Backend Database](#)

Metrics

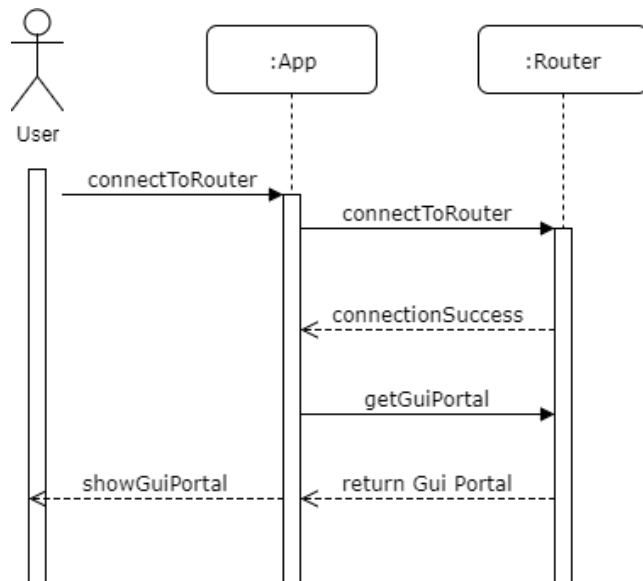
- Ease of use: Technicians and users should be able to use the app without any training and easily maintain routers.
- Speed: Processing must be in real time as to not miss data.

System Sequence Diagrams

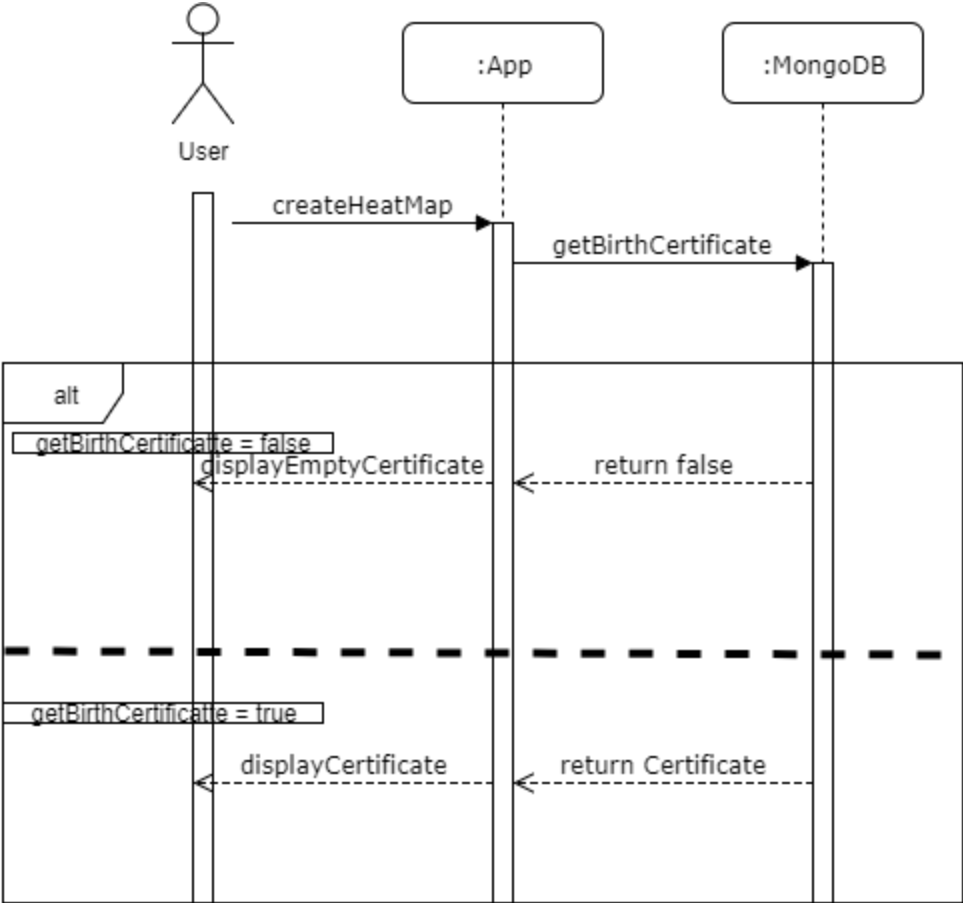
Video Stream Analyzer



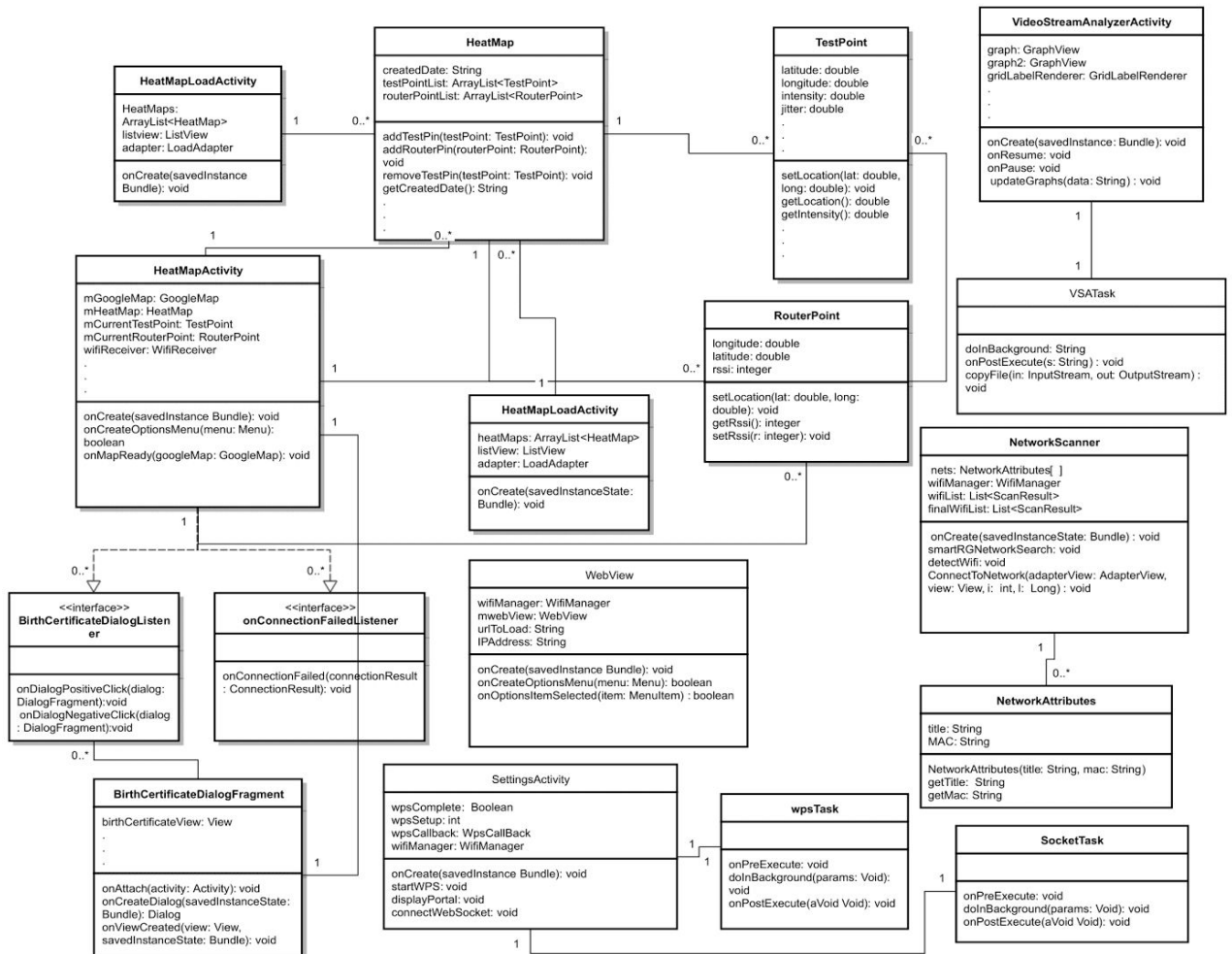
GUI Portal



Get Birth Certificate



UML Diagram



Appendices

Technologies Used:

- MongoDB
- NodeJS
- Android (SDK & NDK)
- Google Maps API
- Google Heat Map API
- GraphView library (will display in graphs data from VSA)
- VSA (C code that will output video stream statistics in the form of JSON)

Meeting Documents

[Google Drive Folder](#)